



Reactive Armor Technologies



**OFFERING PROTECTION OPTIONS
FOR CURRENT AND FUTURE
GROUND VEHICLES**



Reactive armor is designed to enhance a ground vehicle's survivability at a minimum of weight and cost. Reactive armor technology is combat proven, having been decisively applied to fielded combat vehicles such as the Bradley Fighting Vehicle System and the M60 Tank. The modularity and high mass efficiency of reactive armor has enabled these vehicles to be capable of effectively defeating shaped-charge warheads and other anti-armor threats without significant increases in weight and cost. Furthermore, extensive testing of reactive armors outfitted on current U.S. vehicles has demonstrated very low sensitivity of the reactive element in spite of user concerns.

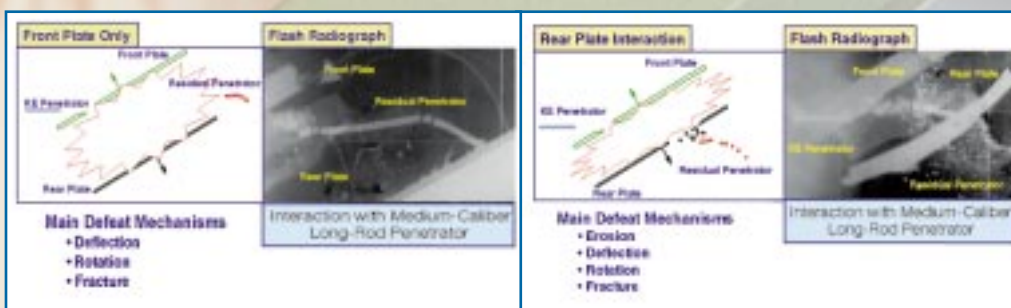
Continued research in reactive armor technologies will provide further increases in performance at reasonable costs. New armor designs, featuring more advanced reactive and passive materials and more effective geometries, will enable the development of combat vehicles that can be tailored to meet advanced threats (such as hypervelocity kinetic-energy penetrators, tandem shaped-charge warheads, and precursors) while being kept at acceptable gross weights. These technologies can be applied to future combat vehicle developments or as appliques to fielded combat vehicles.

EXPLOSIVE REACTIVE ARMOR (ERA)

Explosive Reactive Armor is the most effective proven technology to defeat both chemical-energy and kinetic-energy threats. ERA armors are inexpensive and easy to fabricate and provide good multihit capability in modular configuration. Advanced ERA concepts are considered leap-ahead technology that can provide survivability against emerging anti-armor threats. The major challenges of applying ERA to ground combat vehicles include high indirect costs of storage, logistics, and security associated with the use of an explosive material, high integration weight burden for platforms not designed to accept energetic armor, and subjective user preferences for passive solutions if comparable performance can be obtained.

SELF-LIMITING EXPLOSIVE REACTIVE ARMOR (SLERA)

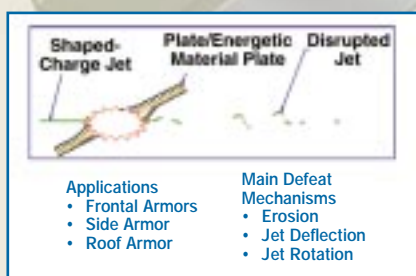
Self-Limiting ERA provides comparable performance to ERA armors with reduced effects on vehicle structures. SLERA is inexpensive and easy to fabricate and can provide good multihit capability in modular configuration, but it is an unproven technology. Although SLERA has the same challenges of application to ground combat vehicles (primarily associated with the use of explosive material), it has the potential of being classified as a passive material (NATO specification). Thus, while the energetic material used in SLERA armors is not as effective as fully detonable explosives, this type of reactive armor may provide a more viable option than ERA.



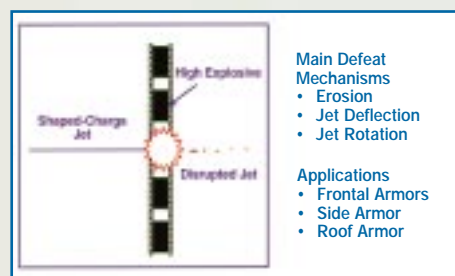
Explosive Reactive Armor for Kinetic-Energy Penetrator Defeat



ERA Multihit Performance



Explosive Reactive Armor for Shaped-Charge Warhead Defeat

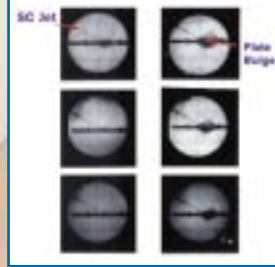


Low-Obliquity Explosive Reactive Armor for Shaped-Charge Warhead Defeat

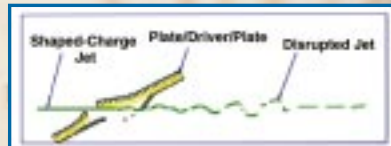


Non-ENERGETIC REACTIVE ARMOR (NERA)

Non-Energetic Reactive Armor is a proven technology that is very effective against CE munitions such as shaped-charge warheads. NERA's advantages over other reactive armor technologies are that it is passive (and thus easy on vehicle structures), inexpensive, and easy to integrate on vehicles. NERA armors provide excellent multihit capability vs. CE threats. Although NERA configurations tested to date are not effective against KE threats, future designs have the potential of defeating medium-caliber KE rounds.



Radiographs showing NERA
Disruption of a Shaped -Charge Jet



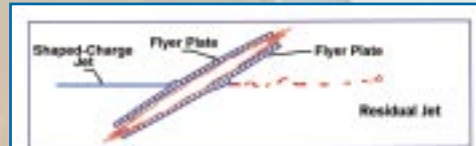
- Applications**
- Frontal Armors
 - Side Armor
 - Roof Armor

- Main Defeat Mechanisms**
- Erosion
 - Jet Deflection
 - Jet Rotation

NERA for Shaped-Charge
Warhead Defeat

Non-EXPLOSIVE REACTIVE ARMOR (NxRA)

Non-Energetic Reactive Armor is a proven technology that is very effective against chemical-energy (CE) munitions such as shaped-charge warheads. NERA's advantages over other reactive armor technologies are that it is passive (and thus easy on vehicle structures), inexpensive, and easy to integrate on vehicles. NERA armors provide excellent multihit capability vs. CE threats. Although NERA configurations tested to date are not effective against kinetic-energy (KE) threats, future designs have the potential of defeating medium-caliber KE threats.

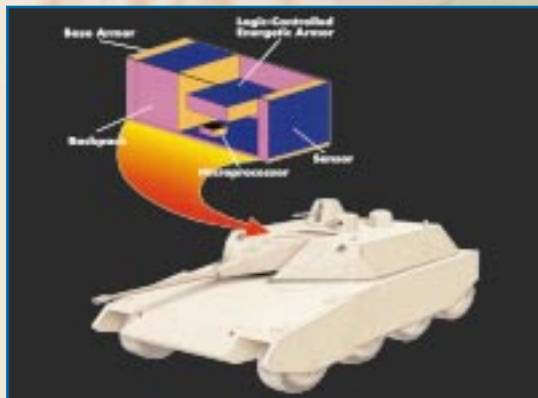


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|--|---|
| Applications | Main Defeat Mechanisms |
| <ul style="list-style-type: none"> • Frontal Armors • Side Armor | <ul style="list-style-type: none"> • Erosion • Jet Deflection • Jet Rotation |

NxRA for Shaped-Charge Warhead Defeat

SMART ARMOR

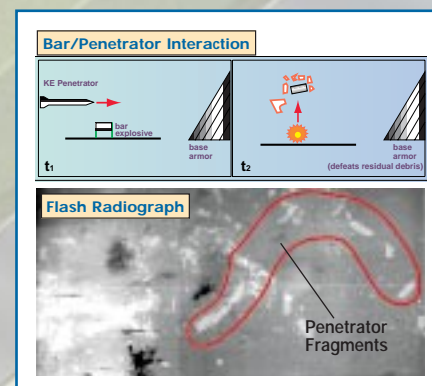
Smart Armor is a novel reactive armor technology that integrates sensors and microprocessors, within the armor envelope, to provide an optimized threat-defeat mechanism at a minimum of weight and space. The sensor determines the impact location, projectile/jet velocity, and projectile/jet diameter, while the microprocessor determines the optimum time to initiate the armor. A highly efficient armor-defeat mechanism features insensitive energetic materials and initiators for increased safety. A part from being unproven in combat, the challenges of applying Smart Armor to ground vehicles include vehicle integration and integration with other advanced technologies, as well as threat discrimination.



Smart Armor for Future Combat Vehicles

MOMENTUM TRANSFER ARMOR

Momentum Transfer Armor is an advanced reactive armor technology that defeats KE threats in an efficient, compact modular configuration. Small bars are explosively launched in a direction perpendicular to the penetration path of a threat projectile to defeat the threat through fracture, deflection, and rotation. This technology is potentially applicable as frontal and side armors on ground vehicles and is being considered as a KE-threat countermunition option for the Army's Full-Spectrum Active Protection Program. Apart from being unproven in combat, the challenges of applying Momentum Transfer Armor to ground vehicles include minimizing the weight of the explosive for an optimum defeat mechanism and achieving robustness against a wide range of threats.



Momentum Transfer Armor for Kinetic-Energy Penetrator Defeat

FOR FURTHER INFORMATION

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